# Esophageal Guidewire-Assisted Nasogastric Tube Insertion in Anesthetized and Intubated Patients: A Prospective Randomized Controlled Study

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**BACKGROUND:** Nasogastric tube (NGT) insertion is indicated almost routinely in patients undergoing abdominal surgery to decompress the stomach intraoperatively and postoperatively, and to allow postoperative tube feeding. NGTs are made of nonreinforced polymer plastic materials and are prone to kinking and coiling during insertion. This often poses difficulty in blind NGT placement or placement assisted by variously described techniques. We hypothesized that esophageal guidewire-assisted NGT insertion with manual forward laryngeal displacement can significantly improve the first-attempt success rate over the technique of head flexion and lateral neck pressure during its insertion in anesthetized and tracheally intubated patients.

**METHODS:** Four hundred eighty adult patients presenting for abdominal surgery under general anesthesia with neuromuscular relaxation were randomized to an experimental technique of esophageal guidewire with manual forward displacement of the larynx (group 1) or a control technique of head flexion and lateral neck pressure (group 2) for insertion of the NGT. The success rates (and failure rate) of the first and second attempts (and overall) were assessed along with the incidence of coiling and kinking of the NGT, procedure-related nasal bleeding and pharyngeal bleeding, and the incidence of moderate and life-threatening complications.

**RESULTS:** The first-attempt success rate was 99.2% in group 1 compared with 56.7% in group 2 ($P < 0.001$). Thus, the first-attempt failure rate was 0.8% in group 1 compared with 43.3% in group 2 ($P < 0.001$, absolute risk reduction of first-attempt failure rate = 42.5%, 95% confidence interval [CI] = 36.0%–49.9%; numbers needed to treat = 2, 95% CI = 2–3; relative risk reduction of first-attempt failure rate = 98.1%, 95% CI = 92.3%–99.5%). The median time required to insert the NGT was significantly shorter in group 1 (55 vs 60 seconds); $P < 0.001$, 95% CI for the difference in means = 3.2 to 6.8 seconds. The incidences of kinking/coiling, bleeding, and moderate injuries were significantly lower in group 1.

**CONCLUSIONS:** Esophageal guidewire-assisted insertion with manual forward laryngeal displacement technique most frequently resulted in correct positioning of the NGT in anesthetized and tracheally intubated patients after the first attempt. This technique is also associated with a lower incidence of procedure-related injuries and is less time-consuming than conventional insertion techniques. (Anesth Analg 2012;114:343–8)

Nasogastric tube (NGT) insertion is almost always indicated in patients undergoing abdominal surgery to decompress the stomach intraoperatively and postoperatively, and to allow NGT feeding. Insertion of an NGT in the anesthetized and tracheally intubated patient has an approximately 50% failure rate in the first attempt when a simple technique of insertion with the head in the neutral position is used.[1] Various techniques of NGT insertion with varying failure rates and complications have been described to address this problem. Common techniques for facilitation of NGT insertion include the use of a slit endotracheal tube, forward displacement of the larynx, the use of various forceps, the use of a ureteral guidewire as a stylet, head flexion, lateral neck pressure, and the use of a gloved finger to steer the NGT after laryngeal impaction.[2–7] We hypothesized that esophageal guidewire-assisted insertion with the manual forward laryngeal displacement technique can improve the first-attempt success rate significantly compared with the conventional technique of NGT insertion with head flexion and lateral neck pressure in anesthetized and tracheally intubated adult patients undergoing abdominal surgery with relaxant general anesthesia.

## METHODS

After receiving approval from our institute's ethics committee, 520 patients older than 18 years of age, scheduled for abdominal surgery with relaxant general anesthesia, were prospectively screened during the preanesthetic evaluation. Patients with a history of corrosive chemical (strong acid or alkali) ingestion, previous esophageal surgery, unstable cervical spine, or head injury were excluded. Eligible patients were approached to consent for participation in the study after a verbal explanation and providing a patient information booklet related to the study. Written informed consent to participate in the study was obtained from each patient. Four hundred eighty-four patients consented to study participation. Four patients did not present for surgery and were excluded from enrollment before

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inclusion in the randomization list. Four hundred eighty patients were randomized in the study.

For all patients, premedication consisted of glycopyrrolate 10 μg/kg IV, ondansetron 0.08 mg/kg IV, and dexamethasone 0.1 mg/kg IV approximately 5 minutes before induction of anesthesia. Patients' lungs were preoxygenated with 100% oxygen for 3 minutes, and anesthesia was induced with propofol 2 to 3 mg/kg IV administered over 20 seconds. Endotracheal intubation was facilitated with succinylcholine 1 mg/kg IV. Immediately after completion of tracheal intubation, NGT insertion was performed in all patients such that the level of muscle relaxation during the procedure remained adequate and consistent. Mechanical ventilation consisted of intermittent positive pressure ventilation with 2% isoflurane and 40% oxygen in air, and surgical muscle relaxation was maintained with vecuronium bromide. Intraoperative analgesia consisted of thoracic epidural analgesia or IV fentanyl infusion as per institutional protocol.

Patients were randomized into 2 groups, group 1 (guidewire group) and group 2 (control group), according to a computer-generated randomization sequence in a prospective serial order. The randomization result for each patient was coded and kept concealed until the patient was anesthetized. The optimal length of insertion of the NGT in each patient was determined by the distance from the tip of the nose to the xiphisternum via the tragus of the ear (nose-tragus-xiphisternal distance). Preoperatively, the nostril to be used for NGT insertion was chosen based on 2 criteria: the amount of fogging produced on a metal tongue depressor during exhalation, and the relative size of the nostril. In all patients, a 14F or 16F, 105-cm ROMOLENE® NGT (Romsons International, Agra, Uttar Pradesh, India) with ball-weighted tip was used.

In the guidewire group, we used a 150-cm Savary-Gilliard® esophageal guidewire, with a progressively flexible spring tip (William A. Cook Australia Pty. Ltd., Brisbane, Australia) (Figs. 1 and 2). After loading an unmodified Savary-Gilliard esophageal guidewire into an NGT of 105-cm length, approximately 45 cm of redundant length of guidewire remains outside the NGT, causing operator inconvenience and difficulty in handling the NGT/guidewire assembly. Thus, the guidewire was cut to a length of 115 cm at the end opposite the spring end for this technique. It is usually difficult for the operator to grip the thin guidewire by hand to remove it after insertion of the NGT, and the wire may become deformed or damaged by this direct grip-and-pull maneuver. Its removal from the NGT may be facilitated by the attachment of a "T-handle" to the nonspring end of the guidewire, which also protects the wire from damage. The nonspring end of the guidewire was made into a closed loop around the hook of a Gigli's wire saw handle to make the modified guidewire (Fig. 1). There is an intrinsic curve of the guidewire as per the manufacturer's specification, which is preserved because of the "memory effect" when stored inside the spiral scaffold provided by the manufacturer. This curve, however, is not fixed. The amount of bend is increased or decreased during the insertion maneuver on encountering resistance from surrounding structures; therefore, the whole assembly follows the "path of least resistance" into the esophagus.

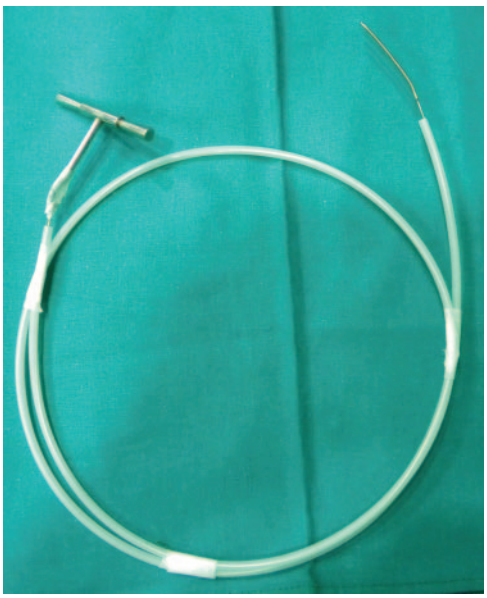

**Figure 1.** Customized Savary-Gilliard spring-tipped esophageal guidewire within its sheath.

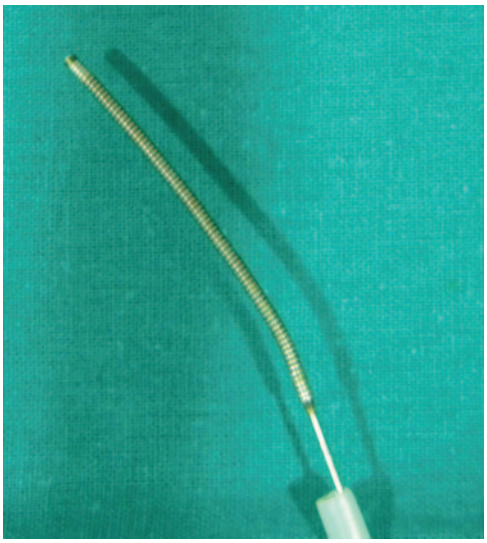

**Figure 2.** Close-up view of the spring-tipped end of the esophageal guidewire.

Before the start of this study, both techniques of NGT insertion were demonstrated to the operators by the principal investigators (JK and TG) (once for each operator) on different anesthetized patients. Subsequently, each operator demonstrated the insertion techniques once on different anesthetized patients to assure uniformity of technique. All operators participating in this study were unaware of the purpose of the study until data acquisition was complete.

Water-based lubricant (2–3 mL) was used to lubricate the drainage port of the NGT and facilitate insertion and withdrawal of the guidewire. The spring-tipped end of the guidewire was then inserted and advanced up to the distal end of the NGT (Fig. 2). The operator stood at the head end of the supine patient while an assistant stood facing the operator a little caudal on the right side of the patient. The

assistant held the outer end of the NGT-guidewire assembly, while the operator inserted the lubricated NGT through the optimal nostril (determined preoperatively). With a wide circular movement, the NGT-guidewire assembly was gently advanced along the floor of the nasal cavity to enter the oropharynx (detected by initial loss of resistance at approximately 10 cm of insertion). A brief and gentle forward traction on the laryngeal cartilage was applied externally by the operator using the thumb and index finger of the left hand, to facilitate passage of the tip of the NGT-guidewire assembly past the cricopharynx. This was followed by further advancement of the assembly along the posterior pharyngeal wall past the cricopharynx into the esophagus. Once the assembly entered the esophagus, the forward traction on the laryngeal cartilage was released and the whole assembly was further advanced up to the calculated optimal length of insertion. Subsequently, the guidewire was retracted by the assistant with a wide circular motion while the NGT was kept stationary by the operator.

Every guidewire was decontaminated by 15-minute immersion in Clenzyme™ 2% v/v solution (BioShields™; Coral Clinical Systems, Alto Santacruz, Goa, India) and then disinfected by immersion in 2% glutaraldehyde v/v solution for 20 minutes. After disinfection, the guidewires were reused.

In the control group, patients had a lubricated NGT inserted gently through the selected nostril, the head being maintained in the flexed position with sustained lateral pressure on the right side of the neck.

In case of failure of insertion in the first attempt in any group, the NGT was completely withdrawn and a second attempt was made to insert the NGT by that same technique. If the second attempt failed, the NGT was introduced under direct vision by direct rigid laryngoscopy and was manipulated using Magill forceps.

An observer (member of the surgical team) not participating in the NGT insertion technique timed the procedure with a stopwatch, noted the number of attempts, and assessed the success or failure of the procedure. Another observer (member of the surgical team), blinded from the randomization code and the technique used for NGT insertion, assessed the occurrence of procedural complications.

In both groups, the initial position of the NGT was confirmed by epigastric auscultation of a gargling sound when 10 mL of air was insufflated via the NGT. Final confirmation of NGT position within the stomach was made by the operating surgeon by manual palpation of the NGT immediately after laparotomy.

The following observations were recorded in each case:

1. Success of the selected technique: first attempt, second attempt, and overall. Failure rate for a particular attempt within each group was calculated by subtracting the success rate from 100%.
2. Time required for completing the procedure successfully. This was defined as the time interval between first insertion of the NGT into the nostril and the positive gastric auscultation sign, measured in seconds.
3. Incidence of coiling and kinking of the NGT.
4. Incidence of procedure-related, minor, self-limiting nasal and/or pharyngeal bleeding.
5. Incidence of moderate injury (mucosal abrasion and bleeding) of the nasal cavity, pharynx, uvula, or epiglottis.
6. Incidence of life-threatening complications arising from NGT insertion during the postoperative period (e.g., esophageal or stomach perforation, severe bleeding, pneumothorax, pharyngeal laceration, and laceration of nasal turbinates).

The sample size required for this study was calculated using the software PS–Power and Sample Size Calculations Version 3.0, January 2009 (©1997–2009 by William D. Dupont and Walton D. Plummer, Jr). Analysis of anesthetic records for the previous 1 year revealed that the incidence of first-attempt success of NGT insertion using a conventional technique was approximately 56% (failure rate of 44%). To detect an improvement of at least 15% in the success rate in the experimental group over the control group, at least 231 experimental subjects and 231 control subjects had to be included in the analysis to reject the null hypothesis (that the first-attempt success rates for experimental and control subjects are equal), with a probability (power) of 0.95 (95%). The type I error probability ($\alpha$) associated with this test of this null hypothesis is 0.05 (5%). Uncorrected Pearson $\chi^2$ statistic was used to evaluate the null hypothesis.

Continuous variables (age, height, weight, and time to insertion success) were tested for normality of distribution using the Shapiro-Wilk normality test. All continuous data variables had a non-normal distribution; the Mann-Whitney *U* test was used to compare these nonparametric variables between the 2 groups. Categorical data (sex and ASA physical status) and proportions (success, failure, and complication rates) were analyzed using the Pearson $\chi^2$ test. A value of $P < 0.05$ was considered statistically significant. Data analysis was performed using SPSS for Windows Release 13.0 (IBM Corp., Armonk, NY). The 95% confidence interval (CI) for the difference in medians was calculated using a Microsoft Excel spreadsheet utility[a] based on the method proposed by Bonett and Price.[8] The risk statistics (absolute risk reduction [ARR], number needed to treat [NNT], relative risk reduction [RRR]), and the 95% CIs for the difference between 2 proportions were calculated using a Microsoft Excel spreadsheet utility[b] based on the method proposed by Newcombe.[9]

## RESULTS

Characteristics of the 2 patient groups are shown in Table 1. The success rates of NGT insertion in the first attempt in the experimental group and the control group were 99.2% and 56.7%, respectively (Table 2). Thus, the failure rate of NGT insertion in the first attempt was significantly lower in the experimental group (0.8% vs 43.3%; $P < 0.001$; ARR of first-attempt NGT insertion failure = 33.7%, 95% CI =

[a] Rink Hoekstra & Henk Kiers, University of Groningen, Groningen, Netherlands. Available at: www.gmw.rug.nl~huisman/spssmanual/medians.xls. Accessed August 29, 2011.
[b] Rob Herbert, George Institute, New South Wales, Australia. Available at: www.pedro.org.au/wp-content/uploads/CIcalculator.xls. Accessed August 29, 2011.

32.6%–43.2%; NNT = 3, 95% CI = 2–3; RRR = 100%) (Table 2). After 2 attempts of NGT insertion, the overall failure rate was nil in the experimental group, and 14.6% in the control group ($P < 0.001$; ARR of failure after 2 attempts = 14.6%, 95% CI = 10.4%–19.6%; NNT = 7, 95% CI = 5–10; RRR = 100%) (Table 2). Thirty-five patients (14.6%) in the control group required pharyngoscopy and instrumentation with Magill forceps for placement of an NGT, whereas none of the patients in the guidewire (experimental) group required such instrumentation. The time for successful placement of NGT in the experimental group was significantly shorter than that of the control group (55 vs 60 seconds, $P < 0.001$, 95% CI for the difference in means = 3.2–6.8 seconds) (Table 2).

The incidences of coiling/kinking, self-limiting bleeding, and moderate injury were significantly lower in group 1 compared with group 2 (Table 3). No patient in either group had any life-threatening complications from the NGT insertion procedure during the postoperative period.

**Table 1. Demographic Distribution of the Study Populations**

| | Group 1 (experimental) ($n$ = 240) | Group 2 (control) ($n$ = 240) |
|---|---|---|
| ASA physical status, no. of patients (%) | | |
| I | 138 (57.5%) | 131 (54.6%) |
| II | 72 (30%) | 78 (32.5%) |
| III | 26 (10.8%) | 27 (11.2%) |
| IV | 4 (1.7%) | 4 (1.7%) |
| Sex, no. of patients (%) | | |
| Female | 125 (52.1%) | 123 (51.3%) |
| Male | 115 (47.9%) | 117 (48.7%) |
| Age (y) | | |
| Mean | 43.7 | 44.5 |
| Median | 42 | 45 |
| SD | 13.9 | 13.8 |
| Interquartile range (minimum, maximum) | 19 (18, 86) | 22 (19, 78) |
| Height (cm) | | |
| Mean | 160.2 | 160.6 |
| Median | 160 | 160 |
| SD | 11.2 | 8.9 |
| Interquartile range (minimum, maximum) | 21 (142, 180) | 14 (145, 175) |
| Weight (kg) | | |
| Mean | 59.8 | 59.2 |
| Median | 58 | 58.5 |
| SD | 12.8 | 12.2 |
| Interquartile range (minimum, maximum) | 19 (36, 92) | 19 (36, 90) |

## DISCUSSION

Various NGT insertion techniques of NGT in awake and anesthetized patients have been described. A frequently used technique involves blind nasal insertion with assistance by external laryngeal manipulation or under direct vision by pharyngoscopy (using a laryngoscope) and instrumentation with Magill forceps. NGTs are made of nonreinforced polymer plastic materials, which are malleable and often pose difficulty in successful insertion. The approximate failure rate of blind nasal placement (with or without external laryngeal manipulation) is 45% to 55%.[1] The technique of NGT insertion under direct visualization by laryngoscopy followed by instrumentation with Magill forceps is often attempted when other techniques fail. However, this technique has significant risks of upper airway trauma[10] and adverse hemodynamic responses[11] that are inherent to laryngoscopy and airway instrumentation. Closed claims analysis has shown that adverse outcomes secondary to respiratory events constitute the single largest source of injury to patients (75%). Six percent of all closed claims were for airway trauma.[10]

The piriform sinuses and the arytenoid cartilages are the most common sites of impaction of an NGT during insertion. Maneuvers to avoid an NGT lodging on these structures include insertion of the NGT along the posterior or lateral pharyngeal wall, flexion of the neck and application of lateral neck pressure,[7] or turning the head to one side.[1,7] Other methods to facilitate NGT insertion include the use of a ureteral guidewire (first-attempt success rate of 66%),[6] use of a slit tracheal tube as a conduit (first-attempt success

**Table 2. Comparison of the Time to Success and the Failure Rates of NGT Insertion**

| | Group 1 (experimental) ($n$ = 240) | Group 2 (control) ($n$ = 240) | Statistical test results |
|---|---|---|---|
| Time to successful insertion of NGT (s) | | | |
| Mean | 54.9 | 90.1 | $P < 0.001$ (Mann-Whitney $U$ test) |
| Median | 55 | 60 | 95% CI for the difference in means = 3.2–6.8 s |
| SD | 7.4 | 43.6 | |
| Interquartile range (minimum, maximum) | 9 (46, 123) | 71 (48, 178) | |
| Failure rate of NGT insertion in the first attempt | 2 of 240 (0.8%) | 104 of 240 (43.3%) | $P < 0.001$ (Pearson $\chi^2$ test)<br>ARR = 42.5% (95% CI = 36.0%–49.9%)<br>NNT = 2 (95% CI = 2–3)<br>RRR = 98.1% (95% CI = 92.3%–99.5%) |
| Failure rate of NGT insertion in the second attempt | 0 of 2 (0%) | 35 of 104 (33.7%) | $P < 0.001$ (Pearson $\chi^2$ test)<br>ARR = 33.7% (95% CI = 32.6%–43.2%)<br>NNT = 3 (95% CI = 2–3)<br>RRR = 100% |
| Overall failure rate (and requirement of pharyngoscopy) | 0 of 240 (0%) | 35 of 240 (14.6%) | $P < 0.001$ (Pearson $\chi^2$ test)<br>ARR = 14.6% (95% CI = 10.4%–19.6%)<br>NNT = 7 (95% CI = 5–10)<br>RRR = 100% |

NGT = nasogastric tube; CI = confidence interval; ARR = absolute risk reduction; NNT = number needed to treat; RRR = relative risk reduction.

**Table 3. Comparison of the Complication Rates Between the Two Groups During NGT Insertion**

| | Group 1 (experimental) ($n$ = 240) | Group 2 (control) ($n$ = 240) | Statistical test results |
|---|---|---|---|
| Coiling/kinking | 2 of 240 (0.83%) | 104 of 240 (43.3%) | $P < 0.001$ (Pearson $\chi^2$ test)<br>ARR = 42.5% (95% CI = 36.0%–48.9%)<br>NNT = 2 (95% CI = 2–3)<br>RRR = 98.1% (95% CI = 92.3%–99.5%) |
| Bleeding | 10 of 240 (4.2%) | 36 of 240 (15%) | $P < 0.001$<br>ARR = 10.8% (95% CI = 5.7%–16.2%)<br>NNT = 9 (95% CI = 6–18)<br>RRR = 72.2% (95% CI = 45.3%–85.9%) |
| Moderate injury | 1 of 240 (0.42%) | 9 of 240 (3.8%) | $P = 0.02$<br>ARR = 3.3% (95% CI = 0.74%–6.6%)<br>NNT = 30 (95% CI = 15–136)<br>RRR = 88.9% (95% CI = 13.0%–98.6%) |

NGT = nasogastric tube; ARR = absolute risk reduction; CI = confidence interval; NNT = number needed to treat; RRR = relative risk reduction.

**Table 4. Comparison of the Success and Failure Rates of NGT Insertion Using the Esophageal Guidewire Technique and Techniques Described in Previous Studies**

| | Esophageal guidewire with forward traction of larynx technique (present study) | Ureteral guidewire technique[7] | Slit tracheal tube technique[7] | Neck flexion with lateral pressure technique[7] | Forward displacement of larynx technique[11] | GlideScope technique[14] | Water-filled NGT insertion technique[15] | Frozen NGT technique[16] | Inflation of esophagus with air via a facepiece[17] |
|---|---|---|---|---|---|---|---|---|---|
| Study sample size | 480 | 200 | 200 | 200 | 100 | 80 | 66 | 100 | 160 |
| Success rate of NGT insertion in the first attempt (experimental versus control) | 99.2% vs 56.7% | 66% vs 34% | 82% vs 34% | 82% vs 34% | 68.8% vs 52% | 85% vs 57% | — | — | — |
| Failure rate of NGT insertion in the first attempt (experimental versus control) | 0.8% vs 43.3% | 34% vs 66% | 18% vs 66% | 18% vs 66% | 31.2% vs 48% | 15% vs 43% | — | — | — |
| Success rate of NGT insertion after second attempt (experimental versus control) | 100% vs 85.4% | 92% vs 72% | 92% vs 72% | 92% vs 72% | — | — | 93.5% vs 65.7% | 88% vs 58% | 96% vs 68% |
| Failure rate of NGT insertion after second attempt (experimental versus control) | 0% vs 14.6% | 8% vs 28% | 8% vs 28% | 8% vs 28% | — | — | 6.5% vs 34.3% | 12% vs 42% | 4% vs 32% |

NGT = nasogastric tube.

rate of 82%),[6] neck flexion with lateral pressure (first-attempt success rate of 82%),[6] lifting the thyroid cartilage (first-attempt success rate of 68.8%),[12] and use of the GlideScope to aid visualization (first-attempt success rate of 85%).[13] However, none of the previously described techniques had a first-attempt success rate comparable to the 99.2% success rate of the technique described in this study (Table 4).

Appukutty and Shroff[6] and Ratzlaff et al.[14] reported that when the NGT was made more rigid by stenting it with a guidewire, it required fewer insertion attempts. However, the incidence of trauma (bleeding) also increased. Similarly, the incidence of tissue trauma is increased when nasal or pharyngeal instrumentation (split endotracheal tube, direct pharyngoscopy, and Magill forceps) is used.

When the NGT reaches a certain depth of insertion (15–20 cm), the most common difficulty encountered is the loss of maneuverability of its advancing tip. This can be circumvented by forward displacement of the larynx (by the operator's left hand) and by using a spring-tipped esophageal guidewire (e.g., the Savary-Gilliard guidewire) introduced inside the NGT to increase its stiffness. The spring tip of the guidewire keeps the tip of the NGT reasonably pliable so as to allow gentle manipulation of the assembly during unanticipated resistance during insertion without causing injury to adjacent soft tissues. Forward displacement of the larynx makes the esophageal inlet patulous and facilitates the entry of an esophageal guidewire-loaded NGT. The distal part of an esophageal guidewire-loaded NGT can be manipulated from a distance of up to 100 cm because of its characteristic design for esophageal instrumentation. We used a Savary-Gilliard esophageal guidewire to increase the remote maneuverability of the NGT tip and found that insertion was successful in 99.2% of patients, compared with a 56.7% success rate in the control group after the first attempt. Additionally, the

incidence of procedure-related minor bleeding (4.2% vs 15%) and soft tissue injury (0.42% vs 3.8%) in the guidewire group was significantly lower compared with the control group. This can be attributed to the use of the esophageal guidewire that imparts some rigidity to the NGT, while maintaining flexibility of the NGT tip. Thus, the NGT-guidewire assembly follows the path of least resistance into the esophagus.

Because NGT insertion was successful in 99.2% of patients in the first attempt and in all patients after the second attempt when using the esophageal guidewire technique, further attempts using direct pharyngoscopy were not required. In contrast, 35 patients (14.6%) in the control group required direct pharyngoscopic-aided insertion after failure of the second insertion attempt. The rates of successful insertion of an NGT after 2 attempts in previously described techniques are 92% (ureteral guidewire technique, slit tracheal tube technique, neck flexion with lateral pressure technique),[7] 93.5% (water-filled NGT insertion technique),[15] 88% (frozen NGT technique),[16] and 96% (technique using inflation of the esophagus with air via a facepiece).[17] However, none of these techniques has achieved a guaranteed success rate of 100% after 2 successive attempts using the same technique alone (Table 4). Therefore, it can be inferred that the esophageal guidewire technique described in this study is a reliable and definitive method for successful insertion of the NGT in anesthetized and tracheally intubated patients. It can be used as a fail-safe technique where other methods have failed.

The incidence of bleeding, minor injury, and moderate injury with the guidewire technique was significantly lower compared with the control group. No life-threatening complications were encountered in any patient, suggesting that the safety profile of the esophageal guidewire technique is acceptable. None of the previous studies was powered sufficiently ($n$ = 66–200) to demonstrate a significant difference in the incidence of bleeding or tissue injury.

In all previous studies, direct laryngoscopy and manipulation of the NGT with Magill forceps was used as the "rescue technique" when NGT insertion failed after the first 2 attempts. In patients with restricted mouth opening or difficult airway, direct laryngoscopic visualization and NGT insertion are difficult and often not feasible. In the esophageal guidewire technique, no such rescue technique was necessary, because NGT insertion was successful in 100% of patients after 2 attempts. Thus, waste of NGTs because of failed attempts can be eliminated, thereby reducing costs. Because this study did not include any children or patients with a history of corrosive chemical injury to the esophagus, previous esophageal surgery, unstable cervical spine, and head injury, the safety and efficacy of the esophageal guidewire technique for NGT insertion cannot be predicted in these patient populations.

## CONCLUSION

We conclude that using the technique of esophageal guidewire with manual forward displacement of the larynx described in this study has near-guaranteed success of NGT insertion in anesthetized and tracheally intubated patients after the first attempt. It can be used as a fail-safe technique where other methods of insertion have failed. It is also safer and less time consuming compared with conventional insertion techniques.

## DISCLOSURES

**Name:** Jyotirmay Kirtania, MD.
**Contribution:** Study design, conduct of study, data analysis, manuscript preparation.
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